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AUTHOR	Kerka, Sandra
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ABSTRACT

The skills most often mentioned in definitions of critical thinking are the ability to think creatively, make decisions, solve problems, visualize, reason, analyze, interpret, and know how to learn. Vocational education should be involved in developing thinking skills for the following reasons: occupations are becoming more reliant on cognitive capacities; the changing work environment requires flexibility and adaptability to changing conditions; and vocational education provides a real-world context for cognitive development. Teaching strategies to develop these skills can be based on three types of cognitive theories: information processing, knowledge structure, and social history. Johnson and Thomas (1992) present five general principles and related teaching methods that integrate all three: help students organize knowledge, build on what students already know, facilitate information processing, facilitate deep thinking through elaboration, and make thinking processes explicit. Teacher behaviors that promote cognitive development and characteristics of classroom environments that support higher order thinking have been identified. Applications in vocational education go beyond giving a lesson or two on thinking skills, as examples in technology education, home economics, agriculture, and cooperative education show. (Contains 11 references.) (YLB)

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ERIC Clearinghouse on Adult, Career, and Vocational Education
Center on Education and Training for Employment
1900 Kenny Road
Columbus, OH 43210-1090

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Higher Order Thinking Skills in Vocational Education

by Sandra Kerka

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From the movement to integrate vocational and academic education to the proposals of the Secretary's Commission on Achieving Necessary Skills (SCANS 1991) and others, the message is clear. Higher order thinking skills are essential and must be taught. Recent findings of cognitive research provide a better understanding of how people learn and how they solve problems, from which new teaching strategies are emerging. This *ERIC Digest* defines higher order skills, presents arguments for developing thinking skills in vocational education and describes strategies and applications in vocational settings.

Why Vocational Education?

The ability to think creatively, make decisions, solve problems, visualize, reason, analyze, interpret, and know how to learn–these skills are most often mentioned in definitions of critical thinking. Characteristics of critical thinkers are perseverance, flexibility, metacognition, transfer of knowledge, problem orientation, open mindedness, use of quality standards, and independence (Lee 1989), a list that resembles many descriptions of the desirable qualities of the future work force. As the nature of work changes and people live and work longer, it is clear that the skills needed for a "40 to 50 year work life" (*Think about It, Too!* 1988) are the capacities to learn continuously through thinking and reasoning, problem solving, decision making, and interpersonal competence. These skills are not only critical to work; they are also needed to deal with the increasingly complex spheres of family, community, and society.

Why should vocational education be involved in developing thinking skills? It is often assumed that this is the role of academic education. However, Thomas (1992) cites the following arguments for vocational education's role: (1) occupations are becoming more reliant on cognitive capacities; (2) the changing work environment requires flexibility and adaptability to changing conditions; and (3) vocational education provides a real-world context for cognitive development. "One of the ways to prepare future employees is to teach students how to think instead of what to think" (Chalupa 1992, p. 21). As the SCANS (1991) report notes, this does not imply a narrow work-focused education. Rather, vocational education is a vehicle for developing the cognitive skills needed for "a productive, full, and satisfying life" (p. vi).

Cognitive research demonstrates that (1) learning is not automatically transferred to new settings; (2) context is critical to understanding; (3) passive learning does not develop cognitive management skills; and (4) higher order learning is not a change in behavior but the construction of meaning from experience (Johnson and Thomas 1992; Thomas 1992). Different teaching strategies, alternative assessment methods, and new ways of teacher preparation are needed.

What Strategies Develop These Skills?

Thomas (1992) identifies three types of cognitive theories upon which teaching strategies can be based. **Information processing theory** explains how the mind takes in information. **Knowledge structure theories** depict how knowledge is represented and organized in the mind. **Social history theory** explains the vital role of cultural context in the development of individual thinking. Together, these three perspectives offer a comprehensive view of cognition. In this view, learning is characterized as an active process in which the learner constructs knowledge as a result of interaction with the physical and social environment. Learning is moving from basic skills and pure facts to linking new information with prior knowledge; from relying on a single authority to recognizing multiple sources of knowledge; from novice-like to expert-like problem solving.

Johnson and Thomas (1992) present five general principles and related teaching methods that integrate aspects of all three perspectives:

1. **Help Students Organize Their Knowledge.** External memory aids such as concept maps (visual representations of concepts and their relationships) ease the information overload on working memory.
2. **Build on What Students Already Know.** Advance organizers such as rules, analogies, or concrete instances help students recognize the similarities between new information and previously acquired knowledge.
3. **Facilitate Information Processing.** Teachers model problem solving, demonstrating their thought processes, strategy selection, and response to mistakes.
4. **Facilitate Deep Thinking through Elaboration.** Cooperative learning techniques such as peer tutoring or paired problem solving (in which one student thinks aloud during the process of solving a problem) make students observe and modify their own thinking processes.
5. **Make Thinking Processes Explicit.** In reciprocal teaching, the teacher models desired metacognitive processes by reading a paragraph, asking questions, summarizing, and predicting what would happen next in the text. Students gradually take on the teacher's role.

These strategies demonstrate that the teacher's role in developing thinking skills differs from traditional instruction. One metaphor for this new role is "a guide on the side rather than a sage on the stage" (Thomas 1992, p. 54). The following **teacher behaviors** promote cognitive development (Chalupa 1992; Lee 1989; Thomas 1992):

- Requiring justification for ideas and probing for reasoning strategies
- Confronting students with alternatives and thought-provoking questions
- Asking open-ended questions
- Requiring students to be accountable for class discussion
- Serving as a master of apprentices rather than a teacher of students
- Using Socratic discussion techniques

Classroom environments that support higher order thinking have the following characteristics (Stasz et al. 1990; Thomas 1992):

- Reflections of real-life situations and contexts
- Collaboration among teachers, disciplines, students
- Encouragement of curiosity, exploration, and investigation
- Responsibility for learning vested in the learner
- Failure viewed as a learning opportunity
- Acknowledgement of effort, not just performance

Chalupa (1992) describes inservice training that helps teachers remodel lesson plans and incorporate knowledge of learning styles in cognitive development. This approach to lesson development involves identifying What is essential for students to know? What is nice to know? What is "fluff"? Learning and teaching styles are assessed by such instruments as the Myers-

Briggs Type Indicator and Watson-Glaser Critical Thinking Appraisal. Higher order thinking objectives specify student performance that requires application, analysis, synthesis, and evaluation of information (Miller 1990).

Assessing the achievement of higher order thinking skills is a challenge because the qualities of learners' thinking and knowledge must be observed, not just their results or products (Thomas 1992). Existing right and wrong answer approaches to testing are clearly inadequate. In fact, "assessment" rather than "testing" is recommended (SCANS 1991; Thomas 1992). New forms of evaluation being developed include the Tailored Response Test, stimulated recall, scenario analysis, and concept mapping. Existing methods such as true/false, multiple choice, and essay can be adapted by having students indicate why an answer is false, asking how two things are similar or different, or requiring evaluation or critique (Chalupa 1992). Scoring can involve giving credit for reasoning (Heyman and Daly 1992).

How Are These Skills Developed in Vocational Education?

- In technology education, the Enterprise Project requires students to design, test, manufacture, and market a product they select. They must use creativity, problem solving, and logic to understand the processes of bringing a product to market and the potential social and environmental impacts (*Think about It, Too!* 1988).
- Home economics students can use cooperative learning, debate, and problem solving to explore how to manage the dual role of homemaker and wage earner (ibid.).
- Agriculture students receive background information on chemical fertilizers and a demonstration by an instructor, extension agent, farmer, or sales representative. Student groups then conduct soil analysis, develop fertilizer application plans, present results, and discuss ethical and soil conservation issues (Haynes and Schroeder 1989).
- Cooperative education students participate in a seminar to analyze and evaluate their internship experiences by keeping weekly logs of facts, activities, and incidents and analyzing them using Bloom's taxonomy of cognitive processes. Students synthesize meaning from their daily work experiences (applying theory to real life), explore their relationship to work and society, and learn about career decision making (Stephenson-Miles 1990).
- Examples of advance organizers in technology education include the analogy of the workings of a flashlight to introduce the concept of electronic circuits, a bicycle to help students understand mechanical advantage and gear ratios, and the human heart as an example of a hydraulic system.
- In revising lesson plans to include higher order components, a traditional lesson objective (writing a resume and application letter), activities (discuss characteristics, create resume), and test questions (list categories of information in a resume and application letter) become—in a critical thinking lesson plan—objectives (examine how the importance of categories of information changes over time, evaluate sample resumes and letters), activities (discuss why one would or would not select a hypothetical applicant), and test questions (given two resumes and letters, select a candidate and justify the reasons) (Chalupa 1992).
- Miller (1990) transforms a typical lesson on nutrients and nutrient deficiency (list and describe classes of nutrients and symptoms of deficiency, read chapter, observe cases of deficiencies, explain three functions of water in the body) into a higher order thinking lesson involving discussion of how components of a balanced diet are determined, diagnosis of symptoms of nutrient deficiencies in a lab activity, and an open-ended test question.

Developing higher-level cognitive capacities goes beyond giving a lesson or two on thinking skills. Applying cognitive development principles in vocational curriculum and instruction builds on the strengths of vocational education to develop higher order skills needed in the spheres of work, family, community, and society.

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THE OHIO STATE UNIVERSITY
1900 KENNY ROAD • COLUMBUS, OHIO 43210